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ABSTRACT

This booklet on energy is one of a series in environmental education for grades K-12. The activities contained within address the effect of culture in determining energy needs, energy loss, and forms of energy. Four basic concepts are listed, along with behavioral objectives, subject areas, key words, and definitions for each. The three activity options associated with each concept include the following information: materials and resources, procedures, discussion questions, further activities, and sample worksheets. These interdisciplinary activities are designed for students in grades 6-8. (MA)

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ENERGY

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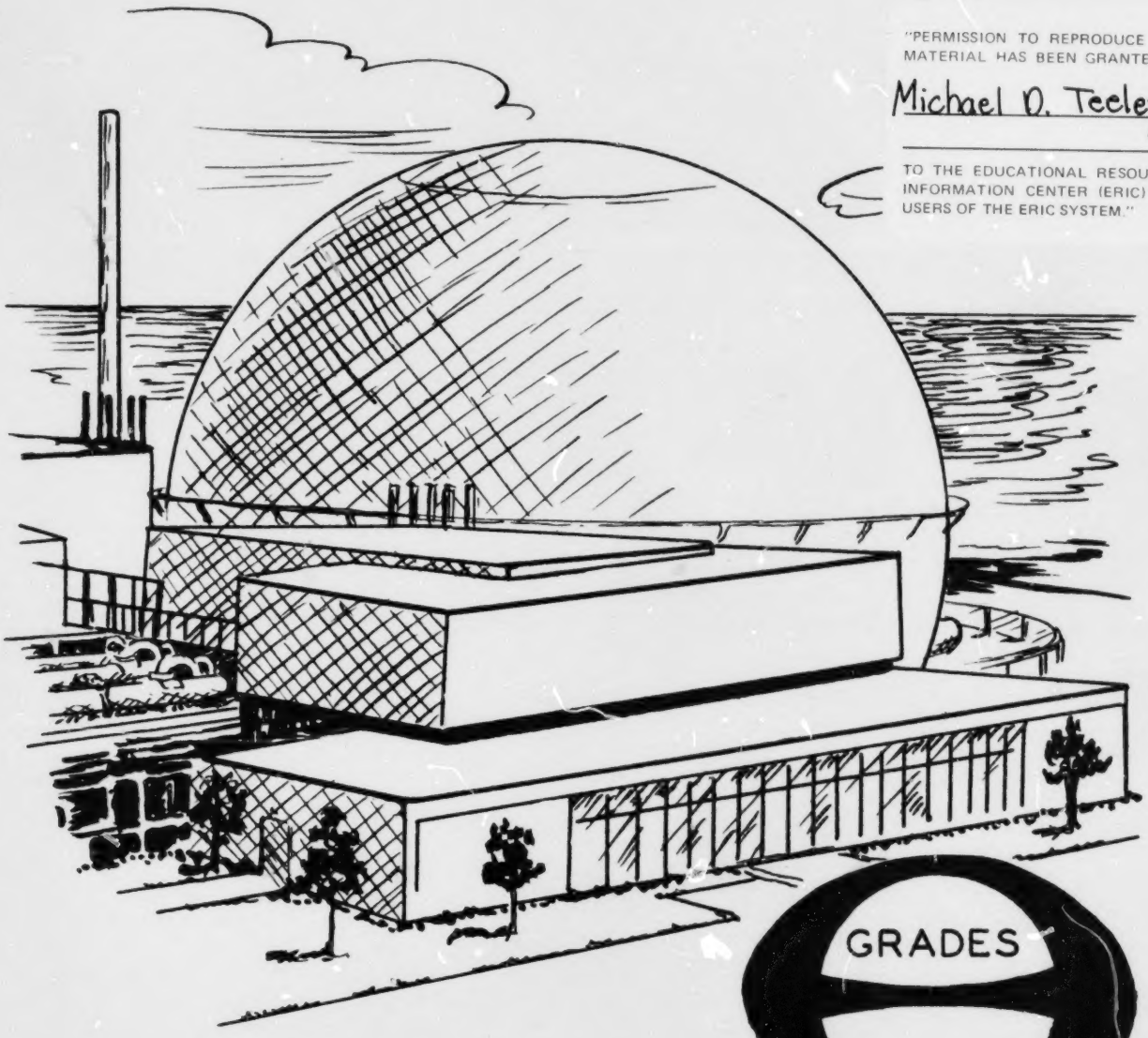

GRADES 8

ENVIRONMENTAL EDUCATION

VALUES FOR THE FUTURE

ANTIOCH COMMUNITY SCHOOL DISTRICT 34

TITLE IV C ESEA

SE 023 456

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Synopsis

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Energy 8: At the completion of this unit the student will be able to explain how energy is rapidly lost during the conversion to a form usable by man.

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EXPLANATION OF CONCEPT AREA

ENERGY - The need for students to understand more about the concept of energy is obvious with all the controversy in recent months.

In dealing with energy, we begin with merely identifying the Sun as the primary source and establishing our need for energy.

We then help the student to discover the ways energy is used by organisms, including man. This is then built upon to identify the various forms of stored energy and the conversions necessary for effective use of energy.

In the junior high we discuss the effect of culture in determining energy needs. Students then explore the ways we lose energy, the scope of the problem, and future needs and forms of energy.

In high school we explore the various aspects of energy in depth. This deals with usage in the United States and in the World, and the various transformations necessary to make energy readily available. Along with the transformations and technology, we explore the problems to be faced and the potential for solving these problems in a manner which will have minimal environmental impact.

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to list ways different cultures use different amounts of energy.

SUBJECT AREAS:

Social Studies, Language Arts, Mathematics

KEY WORDS AND DEFINITIONS:

Culture - The stage of civilization that a group of people is in, consisting of all aspects of that civilization; customs, travel, religion, etc.

OPTION #1

MATERIALS AND RESOURCES

Man: A Cross-Cultural Approach, Education Design Inc., New York

PROCEDURE: A historical view of the development of the American culture might provide an insight to the understanding of how various cultures of today use energy.

1. List on the blackboard the following cultural progressions:

   Hunters and gatherers

   Small subsistence farms

   Home factories

   Industrial revolution - commercial farms

   Post World War II - technological revolution

2. Ask the students to list on their papers next to each lifestyle the following:

   Major food(s), Home styles (building material), Transportation, Recreation (if any)

3. After the students have completed step 2, put a master list on the blackboard.

4. Now have each student rank each culture according to the amount of energy used. Each succeeding culture will use more energy.

5. Now ask the students to place the following countries/cultures into the list at their present stage of development:

   India, Aborigines of Australia, Japan, Masai of Kenya

DISCUSSION QUESTIONS

1. Can we expect developing nations to experience the same growth process that the United States has accomplished?

2. Could the world support its people if all countries operated at the same level of energy use as the United States?

3. Do you think some countries do not want to develop an industrial society?

4. As industry grows so does energy use; how does this complicate the lives of the people?

5. If developing countries grow, what will happen to the United States in terms of energy use and lifestyle?

6. What are some present forms of energy?

7. Do the possible future energy sources allow for the development of nations? Will there be enough?

OPTION #2

MATERIALS AND RESOURCES

A social studies text dealing with different cultures
Man: A Cross-cultural Approach, Educational Design Inc.

PROCEDURE:

1. Divide the class into groups to study a particular culture. The number of cultures studied will depend upon the size of the class and the resources available.

2. Distinct cultures exist in the following areas:

   a. Central Africa
   b. North Africa
   c. Europe
   d. China
   e. Russia
   f. Alaska (Eskimoes)

3. Ask the students to show how the following tasks are completed and what form of energy is used:

   a. Cooking
   b. Heating
   c. Transportation (around town, to and from work)
   d. Entertainment
   e. Manufacturing
   f. Trade

4. Have the students design a presentation to explain how their researched culture compares to our own in areas of need for energy, use of energy, and waste of energy.

DISCUSSION QUESTIONS - The questions will vary depending on the presentations. Three topics should be discussed.

1. Energy conservation

2. Wise use of energy

3. Why is there such a great difference between different cultures?

OPTION #3

MATERIALS AND RESOURCES

Filmstrip: "Transportation" from the kit, Man: A Cross-Cultural Approach, Educational Design Inc., New York, available E^2 Office

Current encyclopedias and resource materials on specific countries

PROCEDURE:

1. The students will investigate various means of transportation such as the auto, animals, rail, plane, bicycle.

2. Show the above listed filmstrip.

3. Have the students select one of the above means of transportation and compare the use of it in at least five countries concentrating on the following areas:

   a. frequency in comparison to population
   b. original cost
   c. cost of energy used
   d. efficiency of energy used

DISCUSSION QUESTIONS

1. List as many different forms of energy as you can. Which of these means of transportation use the most energy? The least?

2. What is the least expensive method for moving large quantities of materials? (water)

3. How does energy and its costs play a major role in the various forms of energy used throughout the world?

4. What countries do you feel could improve on their methods of transportation to use less energy?

5. Do you feel that energy costs have played a major factor in the closing of many passenger railroads in our country? What other factors?

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to explain how energy is rapidly lost during the conversion to a form usable by man.

SUBJECT AREAS:

Science

KEY WORDS:

Potential energy - the distance an object is raised above the ground times its mass.

Energy - the distance an object is moved times the force needed to move it.

Quanta - a very small unit of light energy.

OPTION #1

MATERIALS AND RESOURCES

A board approximately 24"x4"x1" to serve as an inclined plane
Spring balance for measuring forces
Metric ruler
Cart that could be pulled up the inclined plane, weighted if necessary to make readings easier
Petroleum jelly
Large piece of sandpaper
BFA Ecology Activity Cards, BFA Educational Media

PROCEDURE:

1. Set up the board as an inclined plane with any convenient slant. (.5 meters above the floor is suggested for the end of the plane.)

2. Attach the string to the front of the cart. The cart could be any convenient weight. (½ kg would be appropriate.) Pull the cart up the plane using the spring balance reading the "pull" required after it has started moving. Pull the cart to the end of the plane or to wherever the cart will be .5 meters above the ground. Measure the distance the cart moved along the board.

3. Potential energy in a raised object is equal to the distance it was lifted above the ground times its weight. Energy needed to raise the object is equal to distance it was moved along the board times the force used to move it. If no energy is lost, the two products should be the same.

4. Try the experiment several times modifying the surface with sandpaper, petroleum jelly or other materials. Record the results.

DISCUSSION QUESTIONS

1. How did the energy needed to raise the cart compare with its potential energy?

2. How do you explain any difference?

3. Can you say that some energy is always "lost" in every transfer of energy? (It is usually in the form of heat.)

4. Could this be determined in our experiment with the cart?

CHART #1

OPTION #1

EXAMPLE:

MASS OF CART	X	HEIGHT LIFTED ABOVE THE GROUND	=	POTENTIAL ENERGY
PULLING FORCE	X	DISTANCE PULLED ALONG THE PLANE	=	ENERGY EXPENDED

[illegible] PAPER [illegible] ACE		X	=	
		X	=	

PETROLEUM JELLY		X	=	
		X	=	

OTHER		X	=	
		X	=	

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OPTION #2

N-TROW-P

PLAYERS: Four to Six

EQUIPMENT:
Six 4"x4" square beanbags (P's)
Game board 3'x3'
Toss board 4'x4'
ENERGY QUANTA (poker chips)
} all equipment available E^2 Office

red 5 quanta - 30 needed
white 1 quanta - 100 needed
blue 10 quanta - 20 needed
yellow 25 quanta - 20 needed

OBJECT: You are a packet of energy leaving the sun. When you leave the sun you have 100 quanta of energy. The object is to try to reach man retaining at least fifty percent of your energy.

RULES

1. Each player gets 2 yellow, 3 blue, 10 white, and 2 red poker chips.

2. Before the game begins, players roll dice. If they get a one or a six, they take the upper energy chain during the game. Players rolling a two or five, take the middle chain, and players rolling three or four take the lower chain.

3. Players move around the board by tossing the P's and moving the number of spaces indicated above the hole the P's go through. If the P's do not go through the hole, the player must pay five units of energy to get a boost and then move one space.

4. When landing or passing any green space, you must follow the directions on that space.

5. All other spaces apply only if you land directly on them.

6. If you land on a spot already occupied, you must give the player already on the spot (the most recent one if there are more than one) five quanta of energy. This is due to the energy you lost to him in the collision.

Scores:
50 quanta left
49-35 " "
34-20 " "
19-0 " "

γ gamma particles
β beta particles
α alpha particles neutralized

4

OPTION #2 CHANCE CARDS N-TROW-P

Pass over a hot surface. Gain seven quanta. +7	Advance token to next occupied space. Exchange of energy due to collision; you lose eight quanta. −8	Run into high resistance. Lose ten quanta to the bank. −10
Unforseen circumstances. Go to red circle on track at fork and take side route.	Your energy is boosted by collision with high energy radiation source. Gain five quanta. +5	Collision with absorber. Lose fifteen quanta. −15
Collision with poor absorber; lose three quanta −3	Collision with energy source. Gain one quanta. +1	Collision with energy source. Gain 20 quanta but lose 30 by spontaneous decay toward ground state. −10
Collision with neutral object; go back to start of chains, roll die and take chain rolled for except current chain.	Back up two spaces.	Lose ten quanta. −10
Gain ten quanta. +10	Lose five quanta. −5	Gain five quanta. +5
Return to start.	Advance four spaces.	Back up six spaces.

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Chain A and A^1 run diagonally through the gameboard. Chain B and B^1 cover the upper right portion of the gameboard. Chain C and C^1 cover the lower left portion of the gameboard.

A 1 - Sun's energy hits clouds causing a radiation loss of -10.
A 2 - Move to next orange space.
A 3 - Blue space
A 4 - Directional arrow and space
A 5 - Plankton absorbs sunlight -1
A 6 - Directional arrow and space
A 7 - Minnow eats vegetation. If you land on this space, you may try for more efficient way to raise minnows by throwing P's. -2
A 8 - Blue space
A 9 - Directional arrow
A 10 - Small bass eats minnow. -4
A 11 - Directional arrow with this message. If this is your first time past this space, move ahead to the next red spot.
A 12 - Blue space
A 13 - Landing on this space requires that you take new route. Small bass is caught by fisherman. It is undersized and thrown back to die.
A 14 - Directional arrow and space
A 15 - 44" Northern eats bass. -8
A 16 - Blue space
A 17 - Directional arrow and space
A 18 - Fisherman catches Northern, takes it home and cooks it for dinner. -2
A 19 - Directional arrow and space

A_1^1 1 - Directional arrow and space
A_1^1 2 - Dead bass decomposes. -2
A_1^1 3 - Directional arrow and space
A_1^1 4 - Algae grows off of decomposed bass nutrients. -1
A^1 5 - Directional arrow and space

B 1 - Grass absorbs sunlight. -1
B 2 - Directional arrow and space
B 3 - Blue space
B 4 - Directional arrow and space
B 5 - Cow eats grass. If you land on this space, you may try for more efficient way of raising of cattle by throwing p's. -3
B 6 - Energy leaves cow as waste. Take a new route.
B 7 - Directional arrow and space
B 8 - Blue space
B 9 - Directional arrow and space
B 10 - Beef is slaughtered and processed. -7
B 11 - Blue space
B 12 - Directional arrow and space
B 13 - Beef is cooked for dinner. -3
B 14 - Blue space
B 15 - Directional arrow and space

B_1^1 1 - Cow waste begins to decompose. -2
B^1 2 - Directional arrow and space

//

B_1^1 3 - Waste is processed into fertilizer. -6
B_1^1 4 - Directional arrow and space
B_1^1 5 - Fertilizer used to feed crops. -3
B_1^1 6 - Directional arrow and space
B_1^1 7 - Crops are harvested and processed. -6

C 1 - Sunlight heats earth. Much becomes wasted energy. -3
C 2 - Directional arrow and space
C 3 - Hot earth causes water to evaporate. +1
C 4 - Directional arrow and space
C 5 - Blue space
C 6 - Water vapor condenses and falls as rain. -1
C 7 - Rain falls in the valley. Take new route. -6
C 8 - Directional arrow and space
C 9 - Water flows down the river. -3
C 10 - Directional arrow and space
C 11 - Directional arrow and space
C 12 - Water turns generator. If you land on this space, you may try for a more efficient way of turning the generator by throwing p's. -4
C 13 - Excessive friction in the generator. -6
C 14 - Pollution controls put on generator. -5
C 15 - Electricity flows through wires. -1
C 16 - Electricity used by inefficient energy consumer. -7
C 17 - Blue space
C 18 - Directional arrow and space

C_1^1 1 - Directional arrow and space
C_1^1 2 - Water pumped <u>up</u> to storage tanks. +2
C_1^1 3 - Directional arrow and space
C_1^1 4 - Directional arrow and space
C^1 5 - Blue space

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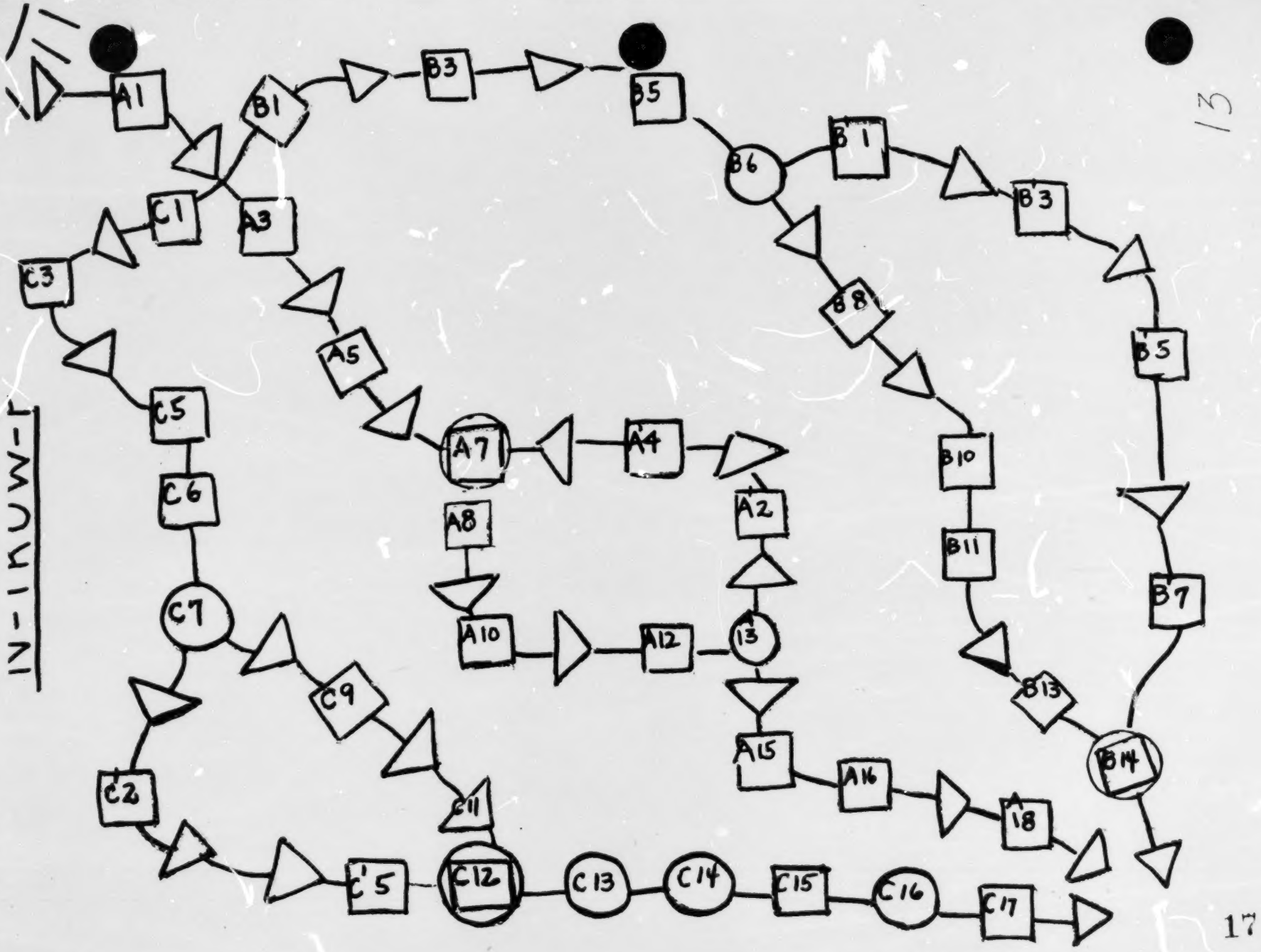
IN-INUW-r
A1
B1
B3
B5
B6
B1
B3
B5
B7
B8
B10
B11
B13
B14
A3
A5
A7
A4
A2
A8
A10
A12
13
A15
A16
18
C1
C3
C5
C6
C7
C9
C11
C2
C5
C12
C13
C14
C15
C16
C17

OPTION #3

MATERIALS AND RESOURCES

Coffee can with a hole at the bottom that will accept rubber tubing
Rubber tubing
Clay, if necessary, to seal tubing to the can
Paddle wheel or anything that will function as one (for example, a gerbil exerciser with popsicle stick paddles, parakeet ball, etc.)
A container to catch the water after hitting the paddle
Tube clamp
Meter stick
Water
Scale

NOTE: If students do this experiment in small groups, multiple quantities of each item will be required.

PROCEDURE:

1. Attach the tubing to the coffee can and seal watertight with clay.

2. Clamp the tubing tightly shut near the can.

3. Fill the can with water and weigh.

4. With the paddle wheel at floor level, direct the stream of water from the tubing on the outside edge of the paddle wheel. The bottom of the can should be about 50 cm above the point where the water hits the paddles. With the tube held steady, count the number of turns the paddle wheel makes until the water can is empty. You might want to color one paddle to facilitate this. It make it more graphic, you may wish to have the paddle wheel lift or drag weight.

5. Weigh the can with any leftover water still left in it.

6. Record the net weight of the water that went down the tube, the distance the hole in the can was above the spot on the paddle wheel where the water hit, and the number of turns the paddle wheel made.

7. Repeat steps 3-6 for three different heights.

8. Determine the circumference of the paddle wheel.

   $C = 2\pi r$ (r = radius $\pi = 3.14$ or $22/7$)

9. Determine potential energy of water for each height.

   (PE = net weight of water times distance of hole above the paddle wheel)

10. Determine work output of system in each case.

    W = net weight of water X circumference X number of turns

If you had paddles move a weight, work output is figured:

W = weight of object moved X distance moved

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OPTION #3 con't

This is a recommended option since it allows the students to see the further loss from a second conversion. This is only visible if you do it both with moving a weight and with just counting the turns of the paddle wheel.

DISCUSSION QUESTIONS

1. How did the input energy (the potential energy of water) compare with the output?

2. How do you account for the difference?

3. Do you think there would be further losses with more energy transfers?

4. Based upon your data, what do you predict the efficiency of a hydro-electric system might be?

$$\text{Efficiency } \% = \frac{\text{output}}{\text{input}} \times 100$$

5. What significance is this result in our society today?

FURTHER ACTIVITIES

1. Have the students design and carry out experiments on other sources of energy, i.e. coal, natural gas, oil, etc.

2. Have the students obtain actual data on real dams to figure out the precise efficiency rating. The following information is needed:

   a. weight of gallon of water
   b. number of gallons that fall through the turbine
   c. distance they fall
   d. energy output of turbine

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to explain why the energy problem is a worldwide problem.

SUBJECT AREAS:

Science, Social Studies

KEY WORDS:

Reserves - materials available for future use

Resource - money or assets which comprise the wealth of a country

Technology - the stage of industrialization of an area

OPTION #1

MATERIALS AND RESOURCES

"Oil: A Finite Fuel", filmstrip from the kit, Energy: A Study of Resources, available E^2 Office

Table of Energy Use and Energy Reserves included

PROCEDURE:

1. Explain to the students that they are going to investigate a major problem in the world today - excessive energy consumption.
2. Give each student a copy of 1) World Crude Oil Reserves and 2) World Energy Consumption.
3. Discuss what each chart means and the information each portrays.
4. Show the filmstrip, "Oil: A Finite Fuel".
5. Ask the students to explain how the film relates to the charts they have.

DISCUSSION QUESTIONS

1. Which countries use the most energy on a per capita basis?
2. If all countries used as much, would there be enough energy available?
3. Assuming that the other countries are trying to increase their standard of living and, as they do, their energy usage will increase, will the major energy consumers have to decrease usage?
4. Is it fair that some countries consume such a vast quantity of the earth's oil reserve?
5. The filmstrip mentions that we use oil 50,000 times faster than the earth can produce it. What are some obvious consequences?
6. How is oil formed in the earth? Can we expect a vast increase in the amount of available oil over the next fifty years?
7. How is oil extracted from the earth?
8. What damage does this do to the earth?
9. What alternatives might be available to supply us with our future energy needs?

FURTHER ACTIVITIES

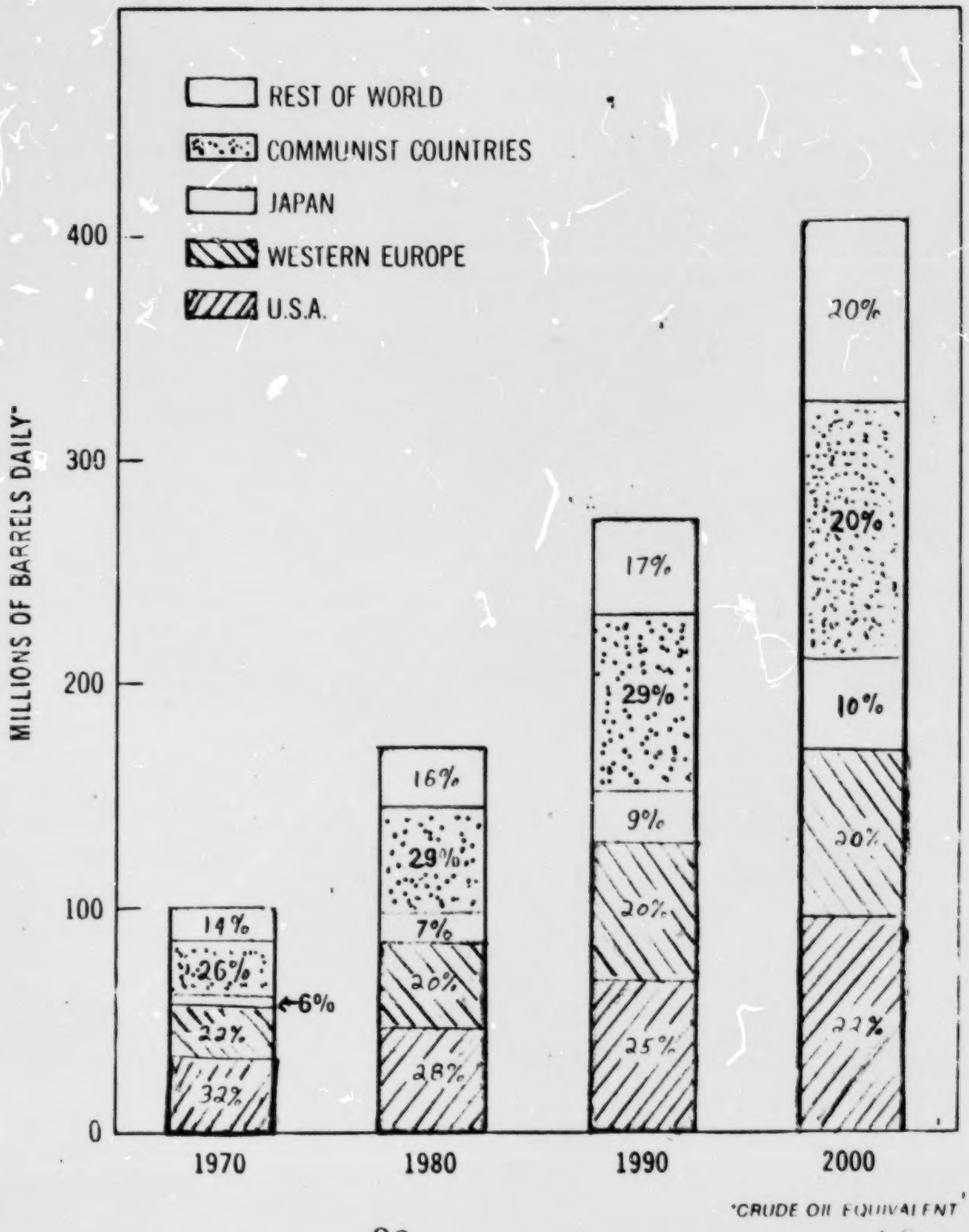
The students may study alternative sources of energy for the years ahead. Two filmstrips, both available from the E^2 Office, could be of use in this study.

"Future Alternatives", from the kit, Energy: A Study of Resources, SVE
"Energy for the Future", from the kit, This World of Energy, National Geographic filmstrips

OPTION #1

CHART

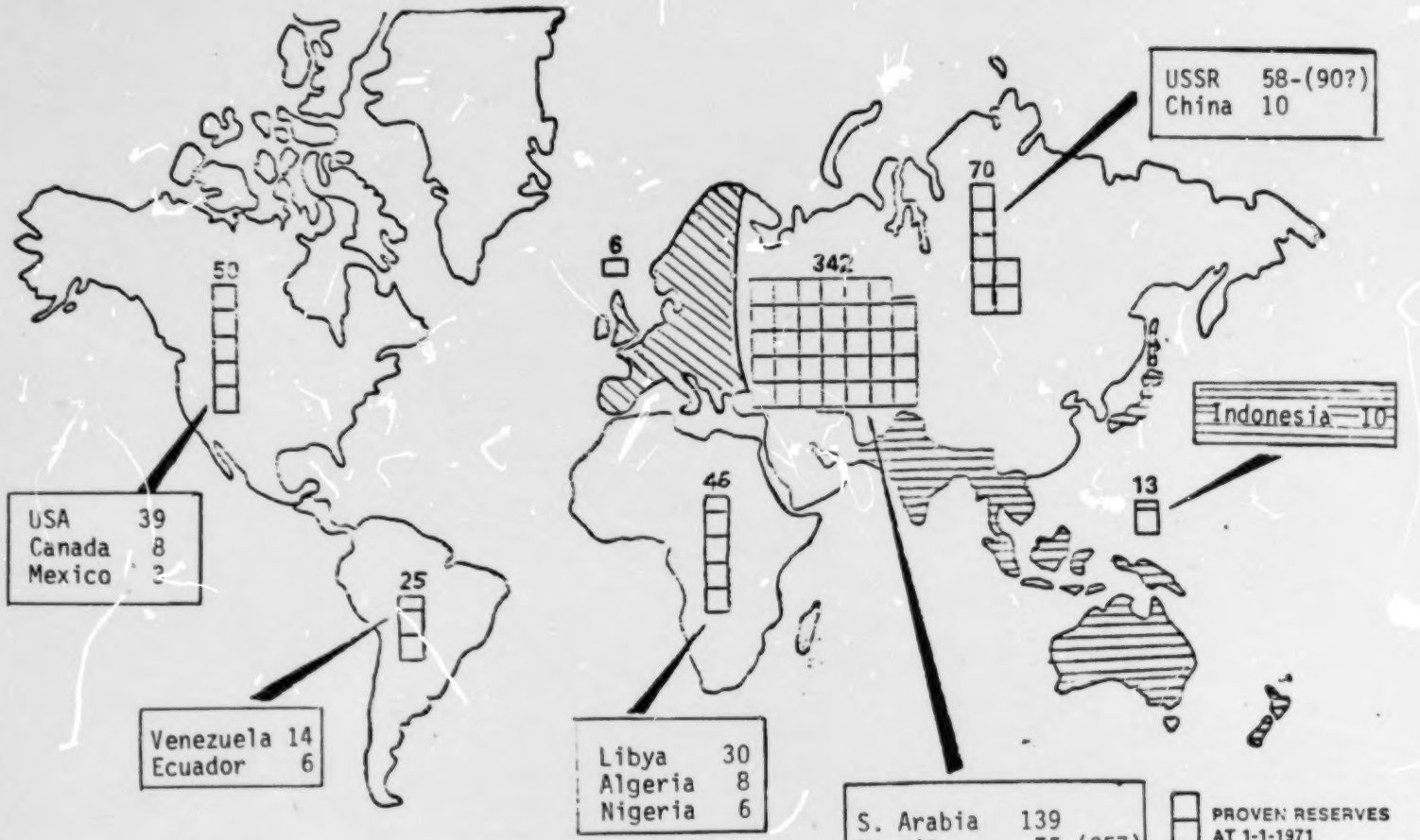
WORLD ENERGY CONSUMPTION



*CRUDE OIL EQUIVALENT

OPTION #1

WORLD PUBLISHED PROVEN CRUDE OIL RESERVES*



*EXCLUDES NATURAL GAS LIQUIDS

SOURCE: WORLD OIL, AUGUST 1972

OPTION #2

MATERIALS AND RESOURCES

Copies of the Energy Quality Index for each student

PROCEDURE:

1. Keep in mind that the EQ Index is a variable. If students want to add any items to the list, delete any items, or change point values, they can do so, as a group, before starting their EQ fieldtrip.

2. Have the group inspect the list, make any necessary changes, and discuss their method of scoring.

3. Have the students break into groups and take an EQ trip as described.

DISCUSSION QUESTIONS

1. In what ways did your EQ trip point out that energy was being wasted?

2. How do you think that the area you studied might compare to other towns, cities, or parts of the world?

3. What can be done to help in alleviating some of these environmental problems? Would this cause more or less energy to be used?

4. Does our area waste energy? How about the rest of our country? The world?

5. Now that you have completed your tour, in what ways would you change the index?

FURTHER ACTIVITES:

Have the students develop other indexes to be used such as environmental quality, traffic quality, etc.

ENERGY QUALITY INDEX

A number of different factors in every situation can be considered to add to or detract from an energy saving environment. In a winderness setting these factors are readily identifiable - no trash, no smoke-laden cars, and etc. - but in an urban setting the influential elements are often lost in a jumble of competing factors.

For this reason it would be helpful to quantify these parameters as to impact and number. A means to this end is a simple do-it-yourself energy quality index. This index makes it possible for individuals or groups to rate, by a simple set of indicators, the quality of a given area. Using assigned values, we can systematically tour an area and determine its energy qualities. Hopefully, through this quantification we can arrive at a measure of energy quality. The basic measurement involves indicators of man's impact on the environment and the devices used to deal with or neutralize the total environment's effects upon man.

THE PROCESS

Taking this basic set of indicators, the students move out on assigned routes in teams of 2-4 individuals. The standard team of four has one driver, two observers, and a recorder. Each team will cover their route twice, one in each direction. Each trip covers a <u>single</u> side of the roadway so as to eliminate duplicity. Given a five mile stretch, the team sholld be able to compute the EQ index in less than a half hour.

CALCULATIONS

Sum of total positive indicators = X
Sum of total negative indicators = Y

Difference of (X-Y) = Z

Z ÷ miles covered (single direction distance only)
Z ÷ distance = EQ/mile

ENERGY INDEX

OBJECT	VALUE	TALLY
DIVIDED HIGHWAY	+1	
NO SMOKING SIGN	+1	
CAR WASH	+1	
TRUCK	+1	
USED CAR LOT	+1	
TRAFFIC LIGHT	+1	
BANK	+1	
TAXICAB	+1	
GARBAGE TRUCK	+1	
SCHOOL BUS	+1	
AMBULANCE	+1	
WELFARE OFFICE	+1	
TREES	+1	
STOP SIGN	+2	
MAIL BOX	+2	
POLICE CALL BOX	+2	
BRIDGE	+2	
SMALL BUSINESS	+2	
SHOPPING MALL	+2	
SUPERMARKET	+2	
TENNIS COURTS	+2	
TELEPHONE BOOTH	+2	
NON-LEADED GAS	+2	
COMPACT CAR	+2	
NO GAS STATION ON CORNER	+2	
TRAFFIC CONTROL DEVICES	+2	
GRASS BETWEEN SIDEWALK AND CURB	+2	

OBJECT	VALUE	TALLY
RAILROAD X-ING	-1	
BAR	-1	
PARKING METER	-1	
TWO PEOPLE PER CAR	-1	
COBBLESTONE STREETS	-1	
BUMPER STICKER	-1	
CHUCK HOLE	-1	
TOW TRUCK	-1	
BILLBOARD FOR ENVIRONMENTAL CAUSE	-1	
EXPRESSWAY	-2	
CAR IN NEED OF AID	-2	
JUNK ON ROAD	-2	
NEON SIGN	-2	
SIGN HANGING OVER SIDEWALK	-2	
TRAFFIC ACCIDENT	-2	
ONE PERSON/CAR	-2	
ALL BLDGS ON BLOCK OVER TEN STORIES	-2	
DRIVE-IN FOOD SPOT	-2	
NO GRASS BETWEEN SIDEWALK AND CURB	-2	
REFINERY	-2	
EXCESS TRAFFIC LIGHTS	-2	
MORE THAN THREE GARBAGE BAGS/HSE	-2	

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Energy index

OBJECT	VALUE	TALLY	OBJECT	VALUE	TALLY
LOCAL SHOPPING	+3		MESSY GARBAGE	-3	
ANTI-LITTER SIGN	+3		NOISY CARS	-3	
HOME GARDEN	+3		LUXURY CARS	-3	
FREIGHTER	+3		EMPTY BUS	-3	
MORE THAN TWO/ PER CAR	+3		HEAVY TRUCKS NEAR HOMES	-3	
ROAD BEING REPAIRED	+4		FLASHING SIGN	-3	
BIKE RIDER	+4		LIGHTS ON DURING DAY	-3	
SMOKESTACK (NO SMOKE)	+4		MOVING SIGN	-4	
LITTER BARREL	+4		SMOKING CAR EXHAUST	-4	
MORE THAN TEN/BUS	+5		CAR IDLING AT CURB	-4	
			TRASH NEAR LITTER BARREL	-4	
			ABANDONED AUTO	-5	
			ABANDONED HOME	-5	

OPTION #3 - one class period

MATERIALS AND RESOURCES

Poker chips in the following quantities:

Red	96	ECONOMY
White	176	TECHNOLOGY
Blue	221	ENERGY

Distribution charts for countries (teacher and student)
Country number tags

PROCEDURE:

1. Write this goal on the blackboard for everyone to see: Countries 1-5 plus 7 must have at least eighteen blue energy chips by the end of round three; others need at least one blue energy chip.

2. Divide the class into ten groups and list the ten countries out of sequence so they will not know their country by number.

3. Explain the three game rules.

   a. Only three trading rounds
   b. No equal trades (one for one) - you must trade once you begin talking to a country
   c. Three minutes per trading round

4. Assign numbers to each group and give them their chip allocations, distribution charts, and goals for round #3.

5. Give them three minutes to organize their teams.

6. Start the first trading round.

7. After three minutes stop the round and tally their resources on the board.

8. Repeat steps six and seven twice.

9. At the end of three rounds identify those countries not having the necessary energy chips.

10. Write a final tally for all categories by team.

DISCUSSION QUESTIONS

1. Can they identify their country by the resources at their disposal?

2. How did team #6 feel knowing it had a powerful position?

3. Which countries had the best bargaining position?

4. Which countries did not reach their energy quota?

5. Were any countries free from trading pressures?

6. What happened to their economy ($) and technology values in trying to get energy, technology, or money?

Option #3 cont.

7. How do we see this process of trading in World politics?
8. Which countries exert the greatest pressures today?
9. Who won? Why?

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TEACHER COPY

COUNTRY	#	START $	START TECH.	START ENERGY	FINAL * $	FINAL * TECH.	FINAL * ENERGY
UNITED STATES	1	16	40	50	12	30	100
RUSSIA	2	8	28	60	13	20	55
JAPAN	3	18	29	14	8	18	30
FRANCE	4	8	18	12	4	19	22
ENGLAND	5	8	18	20	4	20	35
UNITED ARAB REPUBLIC	6	6	2	20	2	20	3
GERMANY	7	14	30	10	4	25	18
VENEZUELA	8	8	2	25	10	10	1
SOUTH AFRICA	9	2	3	5	4	15	1
AUSTRALIA	10	8	6	15	1	8	2

* Cut off this set of data and give the final figures to each team so they know their goals.

i.e. Team 1 gets 12,30,100 as a set
Team 2 gets 13, 20, 55 as a set but not the goals of any other team.

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STUDENT COPY

COUNTRY	#	START $	START TECH.	START ENERGY		FINAL $	FINAL TECH.	FINAL ENERGY
	1	16	10	7				
	2	8	8	8				
	3	18	9	4				
	4	8	8	2				
	5	8	8	2				
	6	6	2	20				
	7	14	10	4				
	8	8	2	4				
	9	2	3	5				
	10	8	6	5				

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BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to explain why existing forms of energy may not be used in the future.

SUBJECT AREAS:

Language Arts, Social Studies, Science, Mathematics

KEY WORDS:

Obsolete - out of date, no longer in use

Alternative - other types, different ways of doing the same thing

OPTION #1

MATERIALS AND RESOURCES

Library materials (encyclopedias)
FS/C Future Alternatives - SVE Energy A Study of Resources C 462

PROCEDURE:

1. Divide the class into eight groups.

2. Ask the groups to research one of the following topics to find sources of energy:

   a. Building of pyramids
   b. Building of Roman roads
   c. Ancient farming
   d. Modern transportation
   e. Ancient forms of transportation
   f. Modern farming
   g. Ancient forms of heating and cooking
   h. Modern forms of heating and cooking

3. Have the students report to the class on their findings. A poster could be used.

DISCUSSION QUESTIONS

1. How have our needs for energy changed?

2. Why do you think forms of energy for heating and cooking are now changing?

3. How has our changing lifestyle caused a change in our energy needs?

4. What do you think our energy needs for heating and transportation will be in the future?

5. What energy forms will be used in the future?

OPTION #2

MATERIALS AND RESOURCES

Three sets of data points
Graph paper master

PROCEDURE:

1. This is basically only for mathematics classes but could be used in science. Have the students plot each set of points. They relate to a form of energy used by man.

2. When they have completed the plotting and have connected the dots, ask them to answer some or all of the discussion questions.

3. If the class does the plotting as a group, you can have a class discussion.

4. You could also assign one of the graphs to each group of abilities within the class. The graphs are arranged from easy to hard (A-C).

DISCUSSION QUESTIONS

1. As time goes by will we rely on different forms of energy? Why? Why not?

2. Which of these forms of energy are the most efficient?

3. Are any of these forms of energy obsolete or nearly obsolete? If so, which ones?

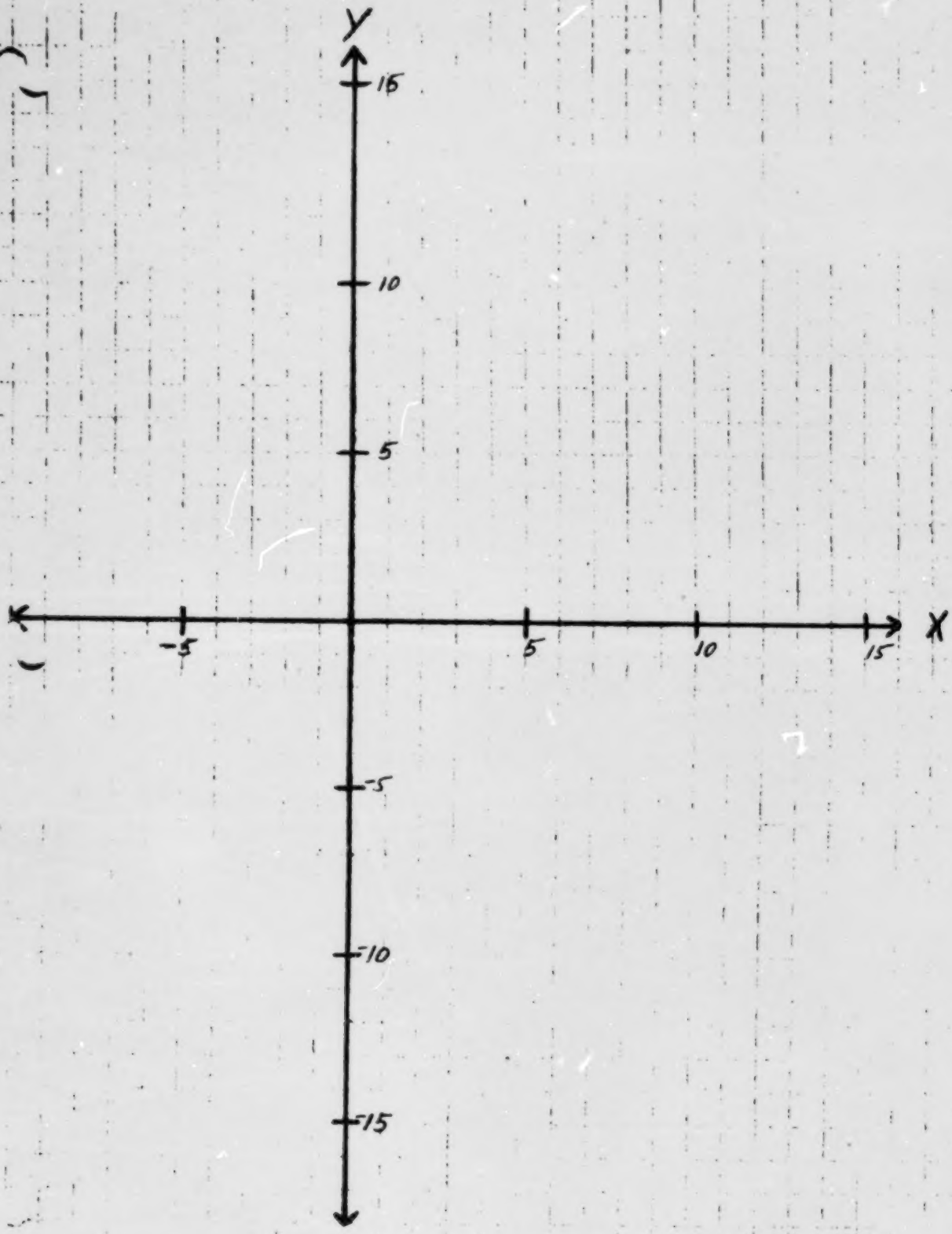
4. Will we have to find other forms of energy? Why?

5. Is there anything significant in comparing the dates of new energy discoveries with the events in the world at that time?

6. How will man be able to keep up with increasing energy demands?

7. What effect does population growth have on energy use?

GRAPH DITTO



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OPTION #2 SET A

PLOT THE POINTS IN SETS AS LISTED BELOW. DRAW A STRAIGHT LINE FROM POINT TO POINT AS INDICATED.

SET 1: AFTER COMPLETION, SHADE IN THIS AREA.

SET 2: CONNECT THESE PAIRS OF POINTS WITH A SINGLE LINE.

SET 1	SET 2	SET 3	SET 4
(-1,8)	(-3,10)+(-6,12)	(-3,8)	(5,-11)
(-2,10)	(-3,12)+(-5,14)	(-3,-11)	(6,-9½)
(-1,12)	(-2,13)+(-3,16)	(-8,-11)	(8,-9)
(0,10)	(-1,13)+(-1,17)	(-7,-13)	(8,-11)
(-1,8)	(0,13) + (1,16)	(5,-13)	(5½,-12) STOP.
	(1,12) + (3,14)	(6,-11)	(4,-11)
	(1,10) + (4,12)	(1,-11)	(5,-9½)
		(1,8)	(7,-8)
		(-1,8)	(9,-8)
			(9,-11½)
			(5,-13) STOP.

SET 1: CONNECT ALL FIVE IN ORDER WITH A STRAIGHT LINE.

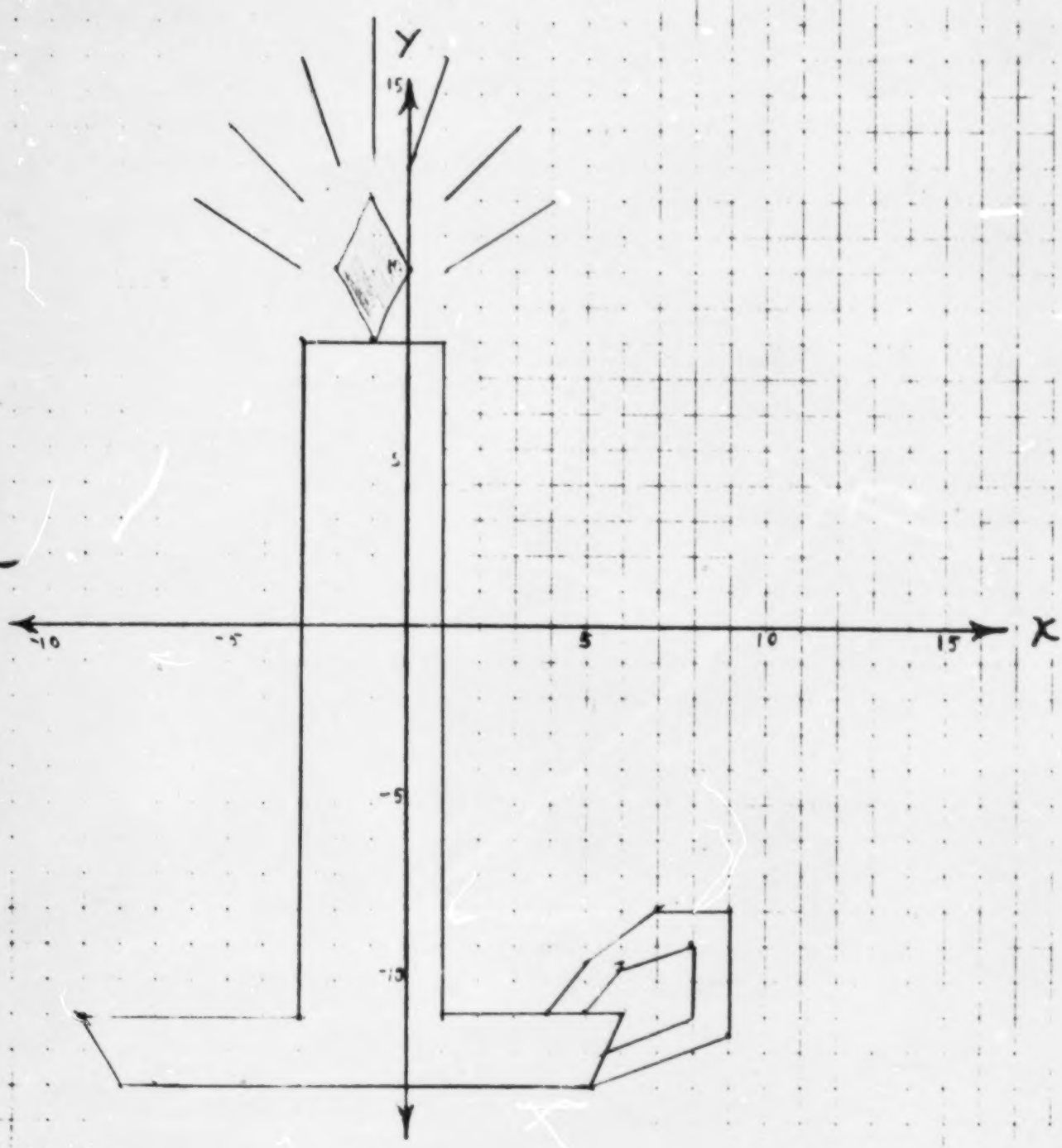
SET 2: CONNECT ONLY THE PAIRS OF POINTS, I.E. (-3,10) AND (-6,12) MAKE ONE LINE.

SET 3: CONNECT ALL POINTS IN ORDER WITH A LINE AS IN SET 1.

SET 4: THIS MAKES TWO SETS, (5,-11) TO (5½,-12) IS ONE SET, (4,-11) TO (5,-13) IS ANOTHER. DON'T MAKE ONE SET.

OPTION #2

SET A



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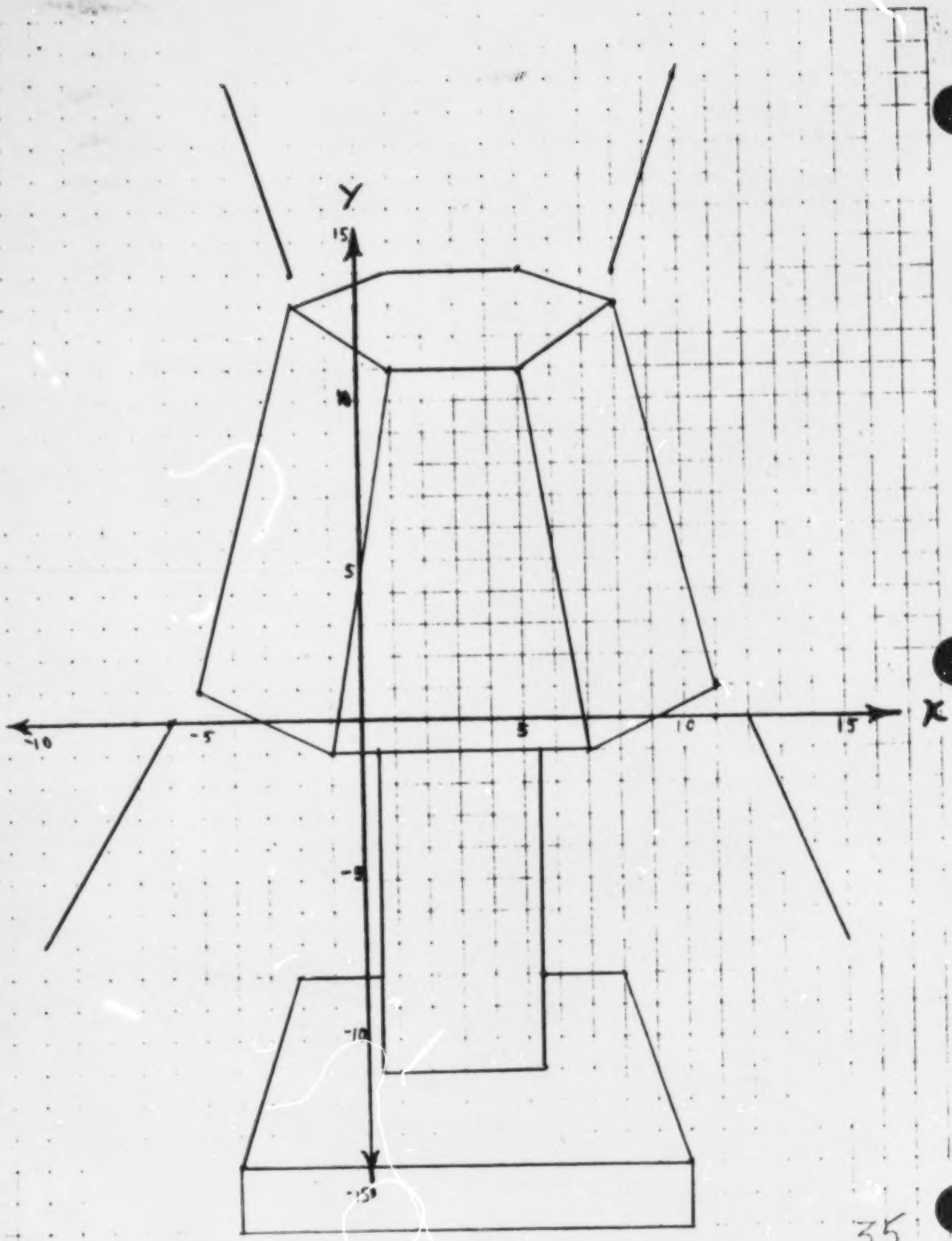
OPTION #2 SET B

PLOT THE POINTS IN SETS AS LISTED BELOW. DRAW A STRAIGHT LINE FROM POINT TO POINT AS INDICATED.

SET 4: CONNECT THE **SETS** OF POINTS WITH A SINGLE LINE.

SET 1	SET 2	SET 3	SET 4
(8,13)	(½,-1)	(5½,-8)	(1,11) (-1,-1)
(11,1)	(½,-11)	(8,-8)	(5,11) (7,-1)
(7,-1)	(5½,-11)	(10,-14)	(-2,14)(-4,20)
(-1,-1)	(5½, -1)	(10,-16)	(8,14) (10,20)
(-5,1)		(-4,-16)	(-6,0) (-10,-7)
(-2,13)		(-4,-14)	(12,0) (15,-7)
(1,11)		(-2,-8)	(-4,-14)(10,-14)
(5,11)		(½,-8)	
(8,13)			
(5,14)			
(1,14)			
(-2,13)			

SET 4: CONNECT ONLY THE PAIRS OF POINTS, I.E. (1,11) AND (-1,-1) MAKE ONE LINE.



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OPTION #2 SET C

PLOT ALL THE POINTS OF ONE SET FIRST; THEN DRAW A SLIGHTLY CURVED LINE FROM POINT TO POINT. DO THE SAME WITH SET 2 AND THEN SET 3.

SET 4: MARK EACH OF THE FOLLOWING POINTS AND ENLARGE THE DOT ABOUT THIS SIZE ●.

SET 1	SET 2	SET 3	SET 4
(0,11)	(16,-6)	(16,9)	(5½,4½)
(1½,13)	(15,-6½)	(16¼,7)	(8½,4)
(2½,14½)	(12,-7)	(16,6)	(8,1)
(3,15)	(8½,-6¾)	(15,4)	(6,-1)
(4,15½)	(5,-6)	(13½,1½)	(3½,-2½)
(5,15)	(4,-5½)	(12,0)	(½,-2)
(5½,14½)	(1,-4½)	(10,-2½)	(1,1)
(7,13)	(0,-4)	(8,-4)	(3,3)
(8,11)	(-2,-2½)	(6,-5)	
(9,9)	(-4¼,0)	(4,-5½)	
(10,5)	(-5,1)	(2,-6)	
(10½,1½)	(-5½,1½)	(0,-6½)	
(10,-2½)	(-7,4)	(-4,-7)	
(9½,-4½)	(-8,6½)	(-6½,-6½)	
(9,-6)	(-8¼,8)	(-8,-6)	
(8,-8)	(-8,9)	(-8½,-5)	
(7,-10)	(-7½,9½)	(-8½,-4)	
(5,-12)	(-6,10)	(-8,-2)	
(4,-12½)	(-3,10)	(-7,0)	
(3,-12)	(2,9)	(-5½,1½)	
(1,-10)	(4,8½)	(-4,3)	
(0,-8)	(7,7½)	(-2,5)	
(-1,-6)	(10,5)	(0,6½)	
(-2,-2½)	(12,3)	(2,7½)	
(-2½,1½)	(13½,1½)	(4,8½)	
(-2,5½)	(14½,0)	(8½,10)	
(-1,8)	(15,-1)	(12,10)	
(0,11)	(16,-3)	(15,9½)	
	(16¼,-5)	(16,9)	
	(16,-6)		

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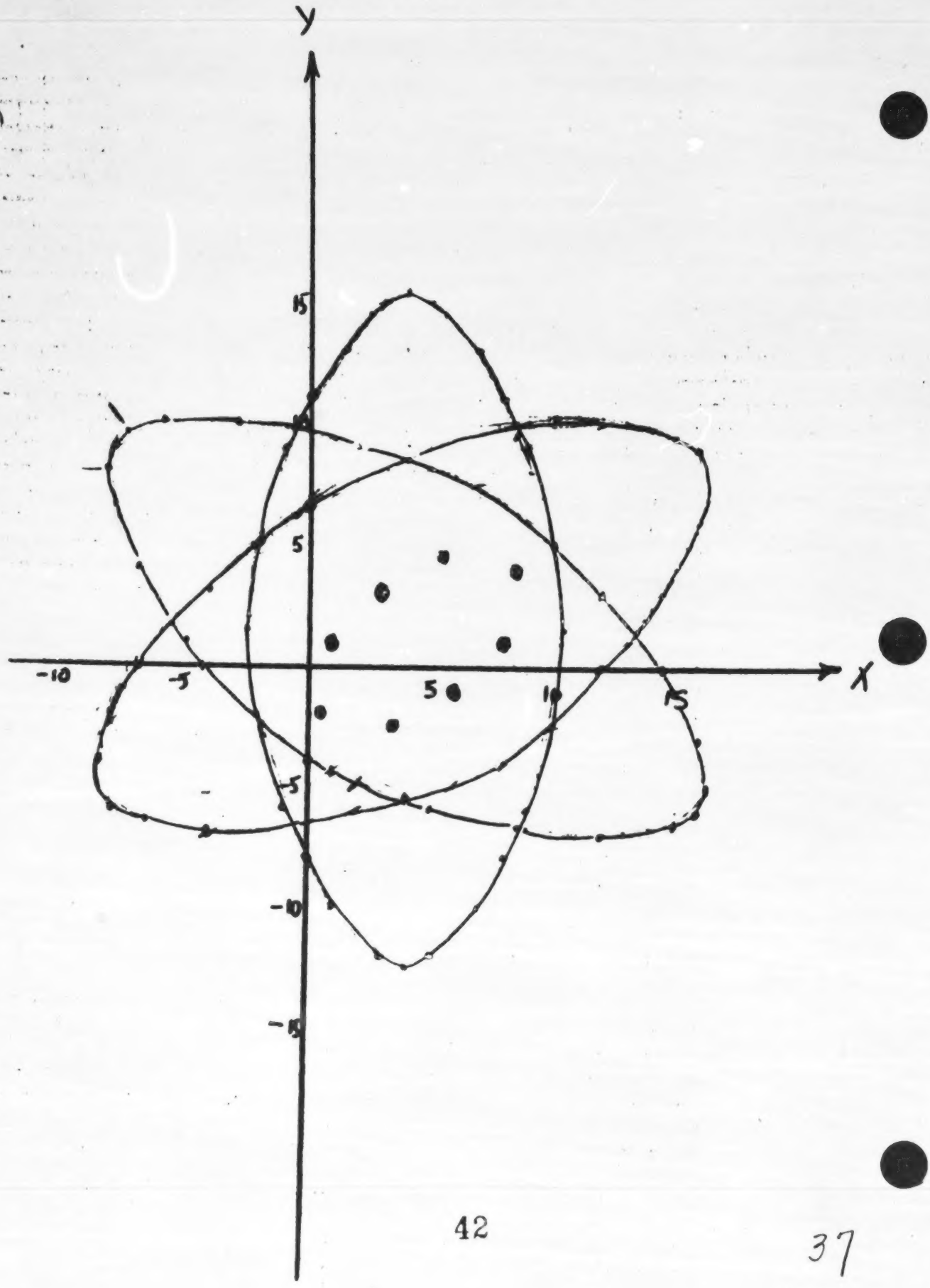
y
15
5
-10
-5
5
10
15
X
-5
-10
-15

OPTION #3

MATERIALS AND RESOURCES

No specific materials needed

PROCEDURE:

1. Divide the class into the following groups:

   a. Five or six students representing a major industry such as General Motors

   b. One third of the remaining class representing Energy Company X

   c. Another one third of the class representing Energy Company Z

   d. The remaining students representing the Environmentalist Groups

2. Distribute the role play descriptions to each group.

3. Allow each group as much time as you feel necessary to develop their energy plans and to choose a spokesman for their group.

4. Once energy plans have been developed, ask the industry group to sit in front of the class forming a panel.

5. The industry group can then call forward the spokesman for each group to present their plans.

6. Anytime the industry group would like to spend time apart from the rest of the groups to decide on the various energy plans, encourage them to do so. While in this caucus explain they may plan to counter propose various aspects of the energy plans.

7. If counter proposals are made, the energy groups should be allowed to meet to consider the proposal and offer their counter proposal.

8. When all parties are heard from, have the industry group announce to which group they are going to grant the contract. It is possible for them to grant separate contracts to each group.

9. If a debate insues let each group develop their arguments.

DISCUSSION QUESTIONS

1. Has the best possible decision been made by the industry group?

2. What considerations have been made by the industry group in purchasing an energy plan?

3. Are their considerations in opposition to the environmentalist group?

4. Who should take the responsibility for developing new forms of energy?

5. Why should we seek new forms of energy?

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OPTION #3 cont.

6. Are there forms of energy we have overlooked?
7. Which form of energy seems to be the best for the future?
8. What sacrifices will be made by industry and by the consumer?
9. How will the change from one form of energy to another influence your life?
10. Do you as an individual have any power to influence the change?

INDUSTRY ROLE

You represent the decision-making executives of your company. You are faced with the following problem. Your company runs all of its machinery by the energy source of oil. However, as the resource of oil dwindles, prices for the oil continue to skyrocket. Your job is to decide on a new energy source and at the same time keep costs at a minimum. You are to devise a feasible energy plan for your company, i.e. how to convert your machinery to a new form of energy over the next 25 years. You may use as many energy sources as you wish. After you have established your energy plan, you will listen to two energy companies' proposals and decide which one best meets your needs.

ENVIRONMENTALISTS

You feel that all fossil fuels are detrimental. They pollute the air; to reach them sometimes means destruction of wilderness areas; to continue to use them undermines the future quality of life. You believe nuclear energy is a better form of energy but the dangerous nature of the fuel itself far outweighs its benefits. You are in favor of further study to make nuclear plants safe. You believe solar energy is the energy of the future. It represents an infinite source of fuel. You believe industry should <u>share</u> the cost of the technology needed to to adapt it to industrial use. You are to develop a 25 year energy plan for the industry company that has the least impact on the environment.

ENERGY COMPANY Z

You are going to devise a 25 year energy plan for the large industry group. They presently use oil as their major source of energy. However, they are seeking a new cheaper form of energy more suitable in the long run.

Your company has been working in two major areas.

(1) You are seeking more oil reserves throughout the world. You are convinced that there is enough oil in the world to last many years. Other countries need to be looked into plus underneath the sea. The cost will be higher than oil is presently but you feel it is justified since no other form of energy is available now any cheaper.

(2) You are convinced that solar energy is the energy of the distant future. It will become available to industry in about fifteen years. The costs are moderate once the technology has been developed. It is the cost of developing this needed technology that prevents faster application of solar energy. Therefore, you feel the cost of developing the technology should be shared in part by those that will use solar power.

ENERGY COMPANY X

You are going to plan a 25 year energy plan for the large industry group. They presently use oil as their major source of energy. However, they are seeking a new, cheaper form of energy more suitable in the long run.

Your company has been working in two areas.

(1) You are interested in using coal as an energy source. There is enough coal to last hundreds of years. The major problem is the air pollution it causes. You have been experimenting with changing solid coal into gas which would lower the pollution factors somewhat. The two major problems are (1) the process will not be ready for commercial use for at least ten years and (2) the cost is very high.

(2) You are interested in using nuclear power at an ever increasing amount. This seems to be, in your company's opinoin, the energy of the future. The cost is high but it is available now. The only problem is the threat of accident which would possibly endanger the lives of hundreds of thousands of people.